

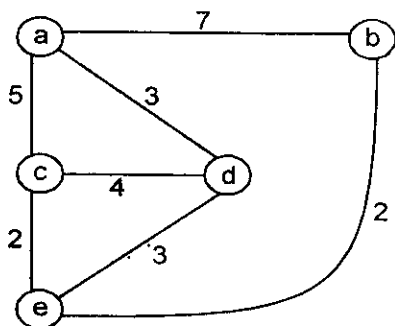
MCA (Revised)**Term-End Examination****MCS-031 : DESIGN AND ANALYSIS OF
ALGORITHMS****Time : 3 Hours]****[Maximum Marks : 100**

Note: Question No. 1 is compulsory. Attempt any three from the remaining questions.

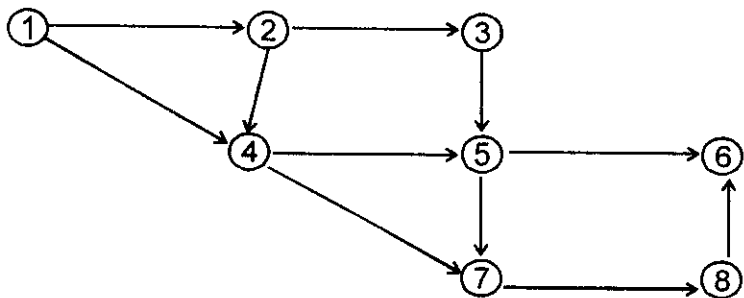
1. (a) Explain Euclid's algorithm for finding GCD of two natural numbers m and n . 5
- (b) Write recursive binary search algorithm and analyse its complexity in worst case. 5
- (c) Define Theta (θ) Notation. Prove that function $f(x) = 5x^4 + 7x + 3$ is $\theta(x^4)$. 5
- (d) Design a Turing Machine (TM) for the language $L = \{a^n b^n c^n : n \geq 1\}$ 5
- (e) Apply Karatsuba Method to multiply the following two numbers: 5026 and 3425. 5
- (f) Use mathematical induction to prove that

$$\sum_{i=1}^n i^2 = \frac{n(n+1)(2n+1)}{6} \quad 5$$

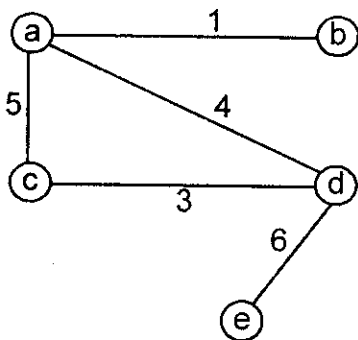
- (g) Write Partition Algorithm for Quick Sort. Analyse its time complexity also. 5
- (h) If L_1 and L_2 are context free languages prove that $L_1 \cup L_2$ is also context free. 5
2. (a) Write Dijkstra's Algorithm to find shortest path in a graph. Apply Dijkstra Algorithm for the following graph ("a" is starting vetex). 10



- (b) Write an algorithm for topological sort. Obtain a topological ordering for the following graph: 10



3. (a) Differentiate between P, NP and NP complete class of problems. 6
- (b) Define Vertex Cover Problem (VCP). Prove that VCP is NP-Complete. 8
- (c) Construct a Deterministic Finite Automata (DFA) for the following Language (i) defined over a set of alphabets $\Sigma = \{a, b\}$.
 $L = \{w : W \in \{a, b\} \text{ and number of } a \text{ in } w \text{ is divisible by } 3\}$. 6
4. (a) Consider the following chain of matrices :
 M_1, M_2, M_3 and M_4 with dimensions: $(5 \times 3), (3 \times 7), (7 \times 10), (10 \times 15)$. Multiply these 4 matrices using Dynamic programming, so that it would take minimum number of scalar multiplications. 10
- (b) Write Kruskal's Algorithm to find minimum spanning tree. Apply Kruskal algorithm to find minimal spanning tree for the following graph: 10



5. (a) Explain Halting problem of Turing machine. 4
- (b) Show that Strassen's Matrix Multiplication algorithm takes $O(n^{2.81})$ time to multiply two matrices A and B, each of dimensions $(n \times n)$. 6
- (c) Explain the following : 10
- (i) Chomsky's classification of Grammar.
- (ii) Ambiguity in Context Free Grammar (CFG).

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